

# THE RÔLE OF THE BACILLUS PROTEUS VULGARIS IN SURGERY.

By MARTIN W. WARE, M.D.,

OF NEW YORK,

SURGEON TO THE GOOD SAMARITAN DISPENSARY, NEW YORK.

THE postulates of Koch are properly always called in requisition whenever the critical moment arrives to assign some specific *rôle* to a newly found organism, or to an organism found in a new abode; yet the arbitrary distinctions which we hold in calling a germ obligatory or facultative in its behavior towards temperature, air, and media under artificial conditions are not freely applicable when these conditions obtain in the human economy. Thus, while the typhoid bacillus is an obligatory pathogenic organism responsible for a decided symptom complex, it can at times, and that many years later, assume the faculty of producing suppurative conditions of the bones or gall-bladder without systemic typhoid manifestations. Then, again, the obligatory specific reaction of organisms becomes subsidiary in the presence of other organisms. Thus, the tubercle bacillus in the presence of the streptococcus produces a type of hectic fever; and how much more septic are diphtheria patients in whom the streptococcus has also taken a foothold. A long period held none other than the ubiquitous staphylococcus and streptococcus responsible for pus lesions, but of late years the coli bacillus occupies a foremost third place. A persistent search, if not in every case, at least in the exceptionally behaving ones, will see a larger number of bacteria responsible for the proper understanding of the variations. In this light we will judge, from what follows, to what extent we may look upon the proteus vulgaris as facultatively pathogenic for the human organism.

*Proteus vulgaris* and its allied forms were first discovered in decomposed meat and animal matter by Hauser;<sup>1</sup> and Escherich<sup>2</sup> found it in the meconium of infants. Foa and Bonomme<sup>3</sup> isolated the *proteus vulgaris* from the blood and viscera of two patients who succumbed from putrid infection due to intestinal obstruction. At the post-mortem the small intestine was found distended and the mesenteric veins thrombosed. Baumgarten<sup>4</sup> thinks that the *proteus vulgaris* may have aided the undoing of this patient, but the hæmorrhagic infection here encountered was merely secondary. Bordogni-Uffreduzzi<sup>4</sup> report the finding of the *proteus vulgaris* in two similar cases, and accord it a pathogenic rôle.

Welch<sup>5</sup> found the *proteus vulgaris* (Zenkeri) in an ovarian abscess associated with salpingitis. Thus far the occurrence of *proteus vulgaris* was more casual than causal.

In 1892, Jaeger<sup>6</sup> found a variety of *proteus vulgaris* (*fluorescens*) in the viscera of patients afflicted clinically with Weil's disease, a form of infectious icterus accompanied by enlargement of the spleen and liver with degenerative changes of both kidneys. Subsequently a small epidemic could be traced to the source of the drinking water which also harbored this organism. This encounter constituted the transition period of the *proteus vulgaris* from a non-obligatory pathogenic organism to that of an organism facultatively pathogenic for the human economy. Very much later Libman<sup>7</sup> found the *bacillus proteus vulgaris* in the pus from a case operated for appendicitis. The day following the patient became jaundiced, and enlargement of the liver and spleen set in, and albumen in the urine made its appearance. Within a few days these distinctive symptoms subsided, and the patient made an uneventful recovery. The existence of an infectious icterus dependent on *proteus vulgaris* was recalled to my mind when the following case, forthwith to be narrated, presented itself.

Male, aged twenty-seven years, resident of Paterson, a silk factory hand, had been ill for three days with severe pain in the

side of the head, face, and neck, accompanied by severe chills and fever each day with marked prostration. The intense pain and difficulty in deglutition he sought to have relieved. His appearance was that of a very sick man, jaundiced sclera and skin, with intense itching of the latter. Temperature (rectal), 102° F.; pulse, 112; spleen enlarged; liver slightly so; glands on the left side of the neck along the sternomastoid enlarged. The saliva dribbled from his mouth and the speech was heavy. Oral inspection: The left half of the tongue was swollen, more so in its posterior half, very elastic and tender. The sublingual area was oedematous. Under local cocaine anæsthesia the surface was seared with the Paquelin, and the abscess aspirated with an all-glass syringe (sterilized). The pus obtained was utilized for cover-glass preparations and for inoculations upon culture media (agar). The abscess was then opened and a drachm of pus evacuated. Drainage with a wick of iodoform gauze. Within five days the abscess cavity went on to complete healing, at the expiration of which time the jaundice had wholly disappeared and the swelling of the liver and spleen were no longer perceptible.

*Bacteriology.*—The cover-glass preparations showed short bacilli and a few short-chained streptococci. The agar tube, after twelve hours in the thermostat, presented a smeary growth. Cover-glass slips from this showed the same short bacillus and isolated long-chained streptococcus. This growth was then plated, the bacilli isolated, and its behavior towards the various media noted. The bacilli were of variable length, about the size of the bacterium termo, in the main slightly rounded ends, and often arranged in parallel chains. The best conception of their configuration can be gained from impression preparations (*klatsch-preparat*). The bacilli retained the color when stained according to Gram. Bouillon is slightly clouded and a scum forms on the surface. A hanging drop from this showed a very active motility. On slant agar the surface has a honey-combed appearance, and the growth is very luxuriant. Stab gelatin (10 per cent.) is liquefied at a room temperature within thirty-six hours, and has a horseshoe-nail appearance. Inoculation on a slant of gelatin shows the liquefaction extending in different directions. Plate cultures on 5 per cent. gelatin brought the features of swarming islands into prominence. The accompany-

ing illustrations will more clearly convey the appearance of the germ's growth. The color of litmus milk was changed, but no coagulation occurred. All of the cultures emitted an offensive odor.

*Inoculation.*—A loopful of the growth from the twenty-four-



FIG. 1.—Cover-glass impression from plate (Zeiss, one-twelfth immersion).

hour agar culture, second generation, was inoculated into two white mice at the root of the tail subcutaneously. After twenty-four hours the mice looked very ill, and within thirty-six hours they died. At the site of inoculation a scant amount of pus was found, and extending from here into the much-enlarged regional

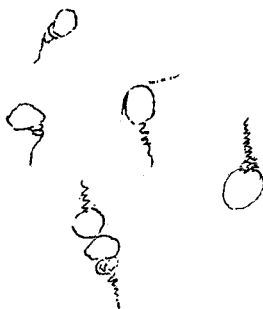


FIG. 2.—Colonies before liquefying (Zeiss, AA).

lymph-glands there were numerous hæmorrhages. The spleen was very much enlarged and the liver slightly so. Cultures from these organs showed the bacillus again, though they were scantily present in both the cover-slips and cultures made from the viscera, and with difficulty found in but a few of the sections of

the viscera. Histologically the study of the viscera showed a degeneration of the cells of the liver, more so than the kidney. In the spleen the follicles were enlarged.



FIG. 3.—Colony showing swarming islands (Zeiss, DD).

Thus biologically this bacillus conforms to the *proteus vulgaris*. In support of the claims of a *proteus* infection, the following reported cases are submitted.

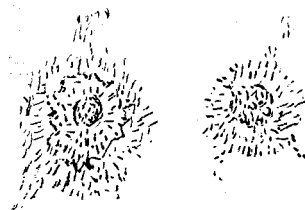


FIG. 4.—Plate colony (Zeiss, AA).

Hauser<sup>8</sup> found the *proteus vulgaris* in a putrid phlegmon of a student who had punctured his finger while working on the cadaver. Within twenty-four hours great œdema and swelling set in. Temperature, 39° C. The impression of the case was one of a phlegmonous erysipelas. Five days later the fever returned, the forearm became swollen, calling for extensive incisions. These abscesses emitted a very putrid, gaseous odor, and for thirty-six days later the pus retained this odor. Furthermore, the granulations looked so poor that tuberculosis was suspected because of the slight rise of the evening temperature. The pus evacuated showed streptococci and termo-like bacilli, which latter by culture proved to be *proteus vulgaris*.

Brunner<sup>9</sup> reports a similar case from which he isolated the *proteus vulgaris*. A boy had punctured his finger beneath the finger-nail; four days later the thumb became swollen and the hand very œdematous. No lymphangitis or lymphadenitis. Temperature, 37.6° C. Incision under ether spray with the evacuation of bad-smelling, hæmorrhagic pus and necrotic tissue. From this the *proteus vulgaris* was isolated from the other accompanying organisms, streptococci and staphylococci.

Karlinski<sup>10</sup> found the *proteus vulgaris* in an ulcer of the leg and in the pus from a pelvic abscess originating from a post-puerperal endometritis.

Bernacchi<sup>11</sup> discovered the *proteus vulgaris* in an old osteomyelitis with a long-standing fistulous opening.

Pfaundler<sup>12</sup> reports the case of a girl originally afflicted with infectious icterus (Weil's disease). On the fourteenth day of the disease a periostitis of the jaw set in, from which the *proteus vulgaris* was obtained in pure culture.

Charrin<sup>13</sup> publishes a case of foetid, purulent pleurisy in a woman who, aborting at eight months, became septic on the seventeenth day, and subsequently died. In the pus obtained from the empyema (operated) a pure culture of *proteus vulgaris* was gained.

Kuhnau<sup>14</sup> found the gangrene in diphtheria cases to be severe when the *proteus vulgaris* was present, and similarly the putrid empyema in phthisical patients was traceable to the presence of the *proteus vulgaris*.

Of all the encounters of the *proteus vulgaris*, perhaps that of Schnitzler<sup>15</sup> has the most direct bearing on the significance of this organism in surgery. He says that it, of all bacteria, alone, without any other factors, is capable of producing cystitis.

Krogius<sup>16</sup> simultaneously and independently made the same observation. The latter says that the clinical course of the cystitis in the presence of the *proteus vulgaris* was in every instance very severe. Krogius reports a lethal exit in two instances, and once he found the *proteus vulgaris* in the blood a few hours before death.

Then Wreden,<sup>17</sup> studying the cause of cystitis, showed that tampons saturated with pure cultures of *proteus vulgaris* inserted into the rectum previously irritated with diluted small quantities of croton oil caused a cystitis by migration of the bacteria along

the lymph channels into the bladder. He also suggests that the same explanation suffices to account for the occurrence of cystitis in uterine carcinoma and in infected conditions of the endometrium.

Melchior <sup>18</sup> in turn substantiates the foregoing regarding the production of cystitis by the proteus vulgaris. He says that the proteus vulgaris is the only bacillus which, introduced into the normally functioning, healthy bladder, without the co-operation of any contributing factor, is capable of producing cystitis. This he explains by virtue of the extraordinary rapidity with which the bacillus causes ammoniacal decomposition of the urine as quickly as it accumulates preliminary to evacuation. In ten instances Melchior found this bacillus in pure culture. They were all very severe forms of cystitis.

Neumann <sup>19</sup> secured the proteus vulgaris from the blood of the heart, spleen, and kidneys of a patient who for years had incontinence of the bowels and bladder due to paralysis. This speaks, says Neumann, for the facultative parasitic characteristics of this organism. The principal focus in this case was a cystitis starting from the rectum.

Tavel and Lanz <sup>20</sup> isolated the proteus vulgaris from a case of peritonitis that died from an incarcerated hernia two days after operation from paralysis of the bowel.

Flexner <sup>21</sup> establishes some claim for the proteus vulgaris as causative of peritonitis. He cites the case of a girl aged eighteen years who succumbed to peritonitis. At the post-mortem there were found mainly a chronic diffused nephritis, pleuritis, pyosalpingitis. The intestinal follicles were swollen and a tubercular ulcer noted in the ileum. From the fibrinoplastic peritonitis the proteus vulgaris was obtained. The case originally was one of ascites due to Bright's disease. Flexner points to this as a contributing cause favoring the invasion of the proteus vulgaris, which statement is concurred in by Welch at the discussion.

Grossman <sup>22</sup> narrates a case of perityphlitis that became jaundiced, and from the pus obtained at the operation he isolated the proteus vulgaris. He also recounts a like case in which the proteus vulgaris was associated with the bacillus coli. These are similar to Libman's case mentioned above.

Finally, Ohlmacher <sup>23</sup> encountered the proteus together with staphylococcus and streptococcus in a fatal case of cerebellar

abscess and leptomeningitis following middle ear disease. He quotes Malinchini, who also reported a similar case of meningitis consequent upon a necrosis of the temporal bone after otitis media.

Every investigator who has encountered this micro-organism has always entertained the question of its bearing towards the disease with which it was associated; and just this question concerns the practical surgeon. The conspicuous citations passed in review will convince us that even if an outspoken attribute cannot be assigned to the proteus vulgaris, it nevertheless assumes at times a dominant characteristic to both influence the local and systemic conditions.

Originally found in decomposed animal matter, it is not at all far-fetched to find its most characteristic action in the instances of peritonitis and pleurisy cited which had their origin in decomposing placental remains. Likewise easy of explanation are the peritonitides originating from lesions in the intestinal tract. The foetid cystitis in women appearing post-puerperally is thus easy of interpretation; and, on the other hand, the foetid cystitis in males can be explained on a tolerably well-accepted theory of the wandering of this organism, a fairly constant inhabitant of the bowel, into the bladder, when urinary stasis exists. Its presence in the ulcer of a leg and in the sinus of the old osteomyelitis, I think, are merely instances of implantation from the anal region, as is so frequently seen in infants and persons of unclean habits in the case of the bacillus pyocyaneus, which so often discolors the pus in wounds of the lower extremities. Most frequently proteus vulgaris is an annoying saprophyte. W. Cheyne<sup>24</sup> puts it down as ever saprophytic. In this claim he is only supported by Baumgarten. Arrayed against these two are all the other observers, whose consensus of opinion is that it, in conjunction with other organisms (symbiosis), assumes a pathogenic significance, either enhancing or supplementing their action. The streptococcus is the most frequent companion of the proteus. In culture media the proteus rapidly over-



grows the streptococci, and furthermore Monti<sup>25</sup> has shown that streptococci lose their virulence as well as their pus-producing capabilities if toxic products of the proteus are simultaneously inoculated into the animals. Hauser corroborates this, wherefore the proteus is so often found in peritonitis, septic endometritis, and eventually in the peritonitis emanating from this. This symbiosis Hauser pictures as follows: The streptococcus causes necrosis. This dead matter favors the growth of the proteus vulgaris, and the latter's poisons in turn impair the resistance of the tissues, which altered vitality again is favorable for the growth of the streptococci. The clinical picture set up by Weil, and elaborated by Jaeger's studies, is thus far the classical expression of the proteus infection or intoxication. The proteus is not capable of producing a primary infection; it only steps to the fore after the bacteria of invasion have rendered effete the living organic matter, then the toxins that have been found in the bodies of the proteus vulgaris (Meyerhof<sup>26</sup>) intoxicate the system.

In conclusion, recurring to my case which inspired this inquiry, I am of the opinion that here, too, the proteus is a secondary infection, and only because of the encountered icterus and enlarged liver and spleen it assumed a pathologic rôle. I do not believe it to be either a metastatic deposit or a primary source for the infection. I picture the infection as follows: The streptococcus so diminished the resistance of the body that the proteus, of greater virulence than ordinarily, acted as in Weil's disease as pointed out by Jaeger. Then followed an implantation or invasion of the proteus into the abscess from its habitat in the mouth as a part of the gastrointestinal tract. Pfaundler's case I likewise think is merely an infection per continuity and not a metastatic abscess.

A befitting conclusion to this summary of these instances of proteus infection is the estimate placed on this organism by Welch,<sup>27</sup> who says, "Although repeatedly observed in inflammations of exposed surfaces in appendicitis, in peritonitis, and even in closed abscesses, in association with other bacteria, it has been generally considered to be non-pathogenic for man;

but our autopsy material has convinced us that it may be pathogenic. It may be unassociated with other bacteria in abscesses and in peritonitis, and it may cause general infection by invading the blood and internal organs."

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